

FUEL INJECTION VALVE BODY FOR DIRECT INJECTION TYPE

INTERNAL COMBUSTION ENGINE

INCORPORATION BY REFERENCE

The disclosure of Japanese Patent Application No. 2000-322581 filed on October 23, 2000, including the specification, drawings and abstract is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a fuel injection valve body for a direct injection type internal combustion engine, in which fuel is injected directly into a combustion chamber of the internal combustion engine.

2. Description of Related Art

A direct injection type internal combustion engine, provided with a fuel injection valve that injects fuel directly into a combustion chamber, executes stratified charge combustion by injecting fuel into the combustion chamber during a compression stroke, thereby improving fuel economy. In stratified charge combustion, it is necessary that fuel injected from the fuel injection valve forms layered rich fuel-air mixture, and that the layered rich fuel-air mixture reaches an ignition plug at an ignition timing. For this reason, it is important that the shape and direction of fuel injected from a nozzle hole of the fuel injection valve body be accurately maintained to ensure a stabilized operation of the internal combustion engine.

If deposits accumulate in the nozzle hole, however, the shape and direction of fuel injected from the nozzle hole may be changed. In such cases, it becomes impossible for layered rich fuel-air mixture to reach the ignition plug at the ignition timing, resulting at times in an unstable operation of the internal combustion engine. The term "deposits" used herein refers to an oxide or a carbide produced when fuel and/or oil are burnt.

Since accumulation of the deposits depends on the temperature of the nozzle hole, as described in, for example, Japanese Patent Laid-Open Publication No. 09-264232, it is important to control the temperature of the nozzle hole to ensure accurate fuel injection. However, the conventional fuel injection valve body for direct injection type internal combustion engines has been insufficient to control the temperature of the nozzle hole. For example, in a conventional fuel injection valve body for direct injection type internal combustion engines as shown in a front view in Fig. 10A and a longitudinal sectional view in Fig. 10B, only a central portion 153a of a nozzle body tip portion 153 exposed to an interior of the combustion chamber protrudes in a conical shape. On the contrary, a peripheral portion 153b is not protruded, therefore, a right-angle corner portion 153d is formed between a nozzle body outer peripheral surface 153c and the peripheral portion 153b. As a result, heat generated by combustion easily concentrates from the periphery at the corner portion 153d. The heat at the corner portion 153d is conducted to a nozzle hole 154, and the temperature thereof also easily increases, resulting in more likelihood of promoting accumulation of deposits. Moreover, a recessed portion 153e formed between the protruding central portion 153a and the peripheral portion 153b enlarges the surface, and heat generated by combustion even further increases the temperature of the corner

portion 153d and the central portion 153a through the enlarged surface. This increases the temperature of the nozzle hole 154 even further, thus promoting accumulation of deposits.

Another conventional arrangement is shown in a front view in Fig. 11A and a longitudinal sectional view in Fig. 11B, in which an entire nozzle body tip portion 203 exposed to an interior of the combustion chamber is protruded in a conical shape. However, a central portion 203a is further protruded from a tip surface 203c of a peripheral portion 203b. Therefore, a recessed portion 203d is formed between the protruding central portion 203a and the tip surface 203c of the peripheral portion 203b. This results in that heat generated by combustion even further increases the temperatures of the peripheral portion 203b and the central portion 203a through a surface enlarged by the recessed portion 203d. This causes a problem that the temperature of the nozzle hole 204 easily increases, thus promoting accumulation of deposits.

SUMMARY OF THE INVENTION

In order to solve the foregoing problems, it is an object of the invention to provide a fuel injection valve body for a direct injection type internal combustion engine that can control the temperature of a nozzle hole.

To achieve the foregoing object a fuel injection valve body for a direct injection type internal combustion engine injects fuel directly into a combustion chamber of the internal combustion engine, according to one aspect of the invention, is shaped such that an entire nozzle body tip portion formed with a nozzle hole and